UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/605,442	06/28/2000	Leon R. Barstad	50439-2	5430

21874 7590 01/03/2006

EDWARDS & ANGELL, LLP
P.O. BOX 55874
BOSTON, MA 02205

EXAMINER	
WILKINS III, HARRY D	
ART UNIT	**PAPER NUMBER**
1742	

DATE MAILED: 01/03/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/605,442	BARSTAD ET AL.	
	Examiner	Art Unit	
	Harry D. Wilkins, III	1742	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 November 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *124-132,134-139,141-156 and 158-167* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *124-132,134-139,141-156 and 158-167* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 June 2000* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 124-132, 134-139, 141-156 and 158-167 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification as filed does not support the claim limitation that the brightener was *any* sulfonopropyl disulfide compound.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 124-132, 134-139, 141-156 and 158-167 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The claims use both "sulfopropyl" and "sulfonopropyl" throughout. However, it appears that these different terms refer to the same thing, thus leading to some confusion as to the actual claim scope. The claims should be amended to consistently use one term, or Applicant should submit evidence showing that the two terms refer to chemically different materials.

5. Additionally, Applicant has not defined what is meant by a "sulfonopropyl disulfide". Which of the materials in dependent claim 139 reads on this scope? Applicant should clearly define what the scope of the claimed "sulfonopropyl disulfide" compounds is.

Specification

6. The disclosure is objected to because of the following informalities: the specification uses both "sulfopropyl" and "sulfonopropyl" throughout. However, it appears that these different terms refer to the same thing. The specification should be amended to consistently use one term, or Applicant should submit evidence showing that the two terms refer to chemically different materials.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 124-132, 134-139, 141-156 and 158-167 are rejected under 35 U.S.C. 103(a) as being unpatentable over Beach et al (US 4,334,966) in view of Bernards et al (US 5,051,154) and further in view of Dubin et al (US 5,972,192).

Beach et al teach (see abstract) a method of electroplating copper that includes electrolytically depositing copper from an electroplating bath containing copper sulfate, water, a suppressor agent (polyether) and 1-100 mg/L of a sulfonated, sulfurized

benzene compound that behaves as a brightener (see col. 2, lines 41-46). The example given (see example 1) is benzene sulfate disulfide, which possesses a molecular weight of less than 1000.

Thus, Beach et al fails to teach (1) that the brightener included a sulfonopropyl disulfide compound and (2) plating on a semiconductor wafer substrate.

Bernards et al teach (see col. 6, lines 29-37) using a bissulfopropyl disulfide as a brightener.

Therefore, it would have been obvious to one of ordinary skill in the art to have used the bissulfopropyl disulfide compound of Bernards et al as the brightener of Dahms et al because the bissulfopropyl disulfide is a conventional brightener in copper electroplating that improves throwing power (see col. 5, line 49 to col. 6, line 13, esp. col. 6, lines 5-10) of the electroplating, thus making plating in vias and trenches more even.

Dubin et al teach (see col. 1, lines 5-40) electroplating copper onto a dielectric silicon layer of a microchip wafer with microvias and trenches.

Therefore, it would have been obvious to one of ordinary skill in the art to have applied the copper electroplating method of Beach et al to the silicon microchip wafer with microvias and trenches of Dubin et al because the method of Beach et al has good copper electroplating characteristics.

Regarding claims 135 and 152, Beach et al teach (see col. 2, lines 47-48) including 20-80 ppm chloride ion.

Regarding claims 136 and 153, while Beach et al and Dubin et al do not expressly teach electrically attaching the silicon wafer to the cathode, due to the underlying electrochemical reaction, the wafer is inherently connected to the cathode. This is also shown to be well known in the art by other art of record.

Regarding claims 137-139 and 154-156, Bernards et al teach using bissulfopropyl disulfide ($NaO_3S(CH_2)_3S\text{-}S(CH_2)_3SO_3Na$).

Regarding claim 160, Bernards et al teach using a sulfopropyl disulfide.

9. Claims 124-132, 134-139, 141-156 and 158-167 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dahms et al (US 3,778,357) in view of Dubin et al (US 5,972,192) and further in view of Bernards et al (US 5,068,013).

Dahms et al teach the invention substantially as claimed. Dahms et al teach (see abstract, col. 3. lines 44-55 and col. 4, lines 5-45) a method of electroplating copper onto a substrate including a souble salt of copper (copper sulfate), a source of chloride ions and a brightener, such as sodium 3-mercaptopropane-1-sulfonate ($HS(CH_2)_3SO_3Na$), at 0.0005 to 0.2 g/L = 0.5-200 mg/L. Thus, Dahms et al teach adding the brightening agent at up to 200 mg/L.

However, Dahms et al do not teach using (1) a suppressor agent, such as a polyether, in the electroplating solution or (2) a sulfonopropyl disulfide compound as the brightener.

Bernards et al teach (see paragraph spanning cols. 2 and 3 and col. 4, lines 31-45) adding a polyether surfactant to a copper plating solution to improve the throwing

power of the solution (i.e.-improved even plating in high aspect ratio through holes (see discussion at col. 1, line 29 to col. 2, line 35).

Therefore, it would have been obvious to one of ordinary skill in the art to have added the polyether surfactant as a suppressor agent to the prior art copper plating solutions because Bernards et al teach that the polyether surfactant has the ability to improve even plating in high aspect ratio features.

Bernards et al teach (see col. 6, lines 29-37) using a bissulfopropyl disulfide as a brightener.

Therefore, it would have been obvious to one of ordinary skill in the art to have used the bissulfopropyl disulfide compound of Bernards et al as the brightener of Dahms et al because the bissulfopropyl disulfide is a conventional brightener in copper electroplating that improves throwing power (see col. 5, line 49 to col. 6, line 13, esp. col. 6, lines 5-10) of the electroplating, thus making plating in vias and trenches more even.

Regarding claims 137-139, Dahms et al teach using 3-mercaptopropane-1-sulfonate, which fits the formula XO_3S-R-SH.

Regarding claim 141, the sodium 3-mercaptopropane-1-sulfonate ($HS(CH_2)_3SO_3Na$) has a molecular weight of 170.

Regarding claims 135 and 152, Dahms et al teach (see col. 4, lines 54-56) adding a source of chloride ions.

Regarding claims 136 and 153, Dahms et al teach (see Example 2) using the substrate as the cathode (i.e.-electrically connected to the cathode).

Response to Arguments

10. Applicant's arguments with respect to claims 124-132, 134-139, 141-156 and 158-167 have been considered but are moot in view of the new ground(s) of rejection.

11. Additionally, the Examiner stands behind the statements made in the previous office action with respect to the suitability of using the electroplating bath of Beach et al or Bernards et al or Dahms et al for a microelectronic workpiece.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Harry D. Wilkins, III whose telephone number is 571-272-1251. The examiner can normally be reached on M-F 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy V. King can be reached on 571-272-1244. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Harry D Wilkins, III
Examiner
Art Unit 1742

hdw